REMARKS

Claims 1-64 are pending in this application. Claims 13-52 stand withdrawn.

By this Amendment, claims 1 and 53 are amended to incorporate features recited in claims 5 and 57, respectively, and to recite additional features disclosed in the specification (see the published application at, for example, page 2, lines 7-12; and page 12, lines 1-3 and 11-13).

Claims 5 and 55 are amended to delete the features incorporated into claims 1 and 53.

Reconsideration of the application is respectfully requested.

The Office Action rejects claims 1-12 and 53-64 under 35 U.S.C. §103(a) over U.S. Patent No. 5,729,094 to Geis et al. ("Geis") in view of U.S. Patent No. 4,506,284 to Shannon ("Shannon"). This rejection is respectfully traversed.

As outlined above, claims 1 and 53 are amended to recite:

1) the element comprises a material or a material system being prepared so as to reduce electron scattering within the material or material system by having a predetermined crystal orientation perpendicular to the first or second surface, <u>and by having an impurity concentration of less than 10^{14} cm^{-3}</u>, and

2) the material layer has a thickness in a direction at least substantially perpendicular to the first or the second surface, which is equal to or larger than 0,2 μm.

Regarding amendment 1), by incorporating claim 5 (or claim 57), it has been specified that the material or material system has an impurity concentration less than 10^{14} cm^{-3} (marked by underlining).

Regarding amendment 2), the addition to the claims is derived from the application text as filed. Basis may be found in the published application where it is implied on page 2, lines 7-12 that quasi-ballistic transport through material layers has so far only been considered when the material layer has a thickness smaller than the mean free path of the electron, which is "*at best of the order of some one to two thousand Angstroms*(= 0,1 - 0,2 μm)". One object

of the present application is to provide a device in which quasi-ballistic transport can take place over macroscopic distances (page 12, lines 1-3) (macroscopic meaning larger than the atomic/molecular scale of the matter), or over distances larger than the substrate thickness (thickness of the order of normal mean free path at room temperature) used in known devices (page 12, lines 11-13).

Geis and Shannon do not disclose or suggest the subject matter recited in the amended claims 1 and 53.

Geis discloses an electron emitter using IB-diamond as the emitter material, where the energetic electrons, leaving the emitting surface have energies in excess of 100 eV. The large energy of the emitted electrons leads to a drawback, namely a large energy and momentum spread of the emitted electrons. In the present application, low energetic electrons may be emitted and the scattering reduction configuration may be done in order to minimize the energy/momentum spread of the emitted electrons.

Geis discloses direct electron emission current data for the material IB-diamond, and nitrides and SiC are mentioned as possible candidates, all material being "wide band gap" materials. This is contrary to the present application, which is also directed to such semiconductor materials as Si, Ge, III-V semiconductors and II-Vi semiconductors, which cannot be considered wideband semiconductors.

The active (energetic electron generating) region as disclosed in Geis must be subjected to very large electrical fields between 10^5 and 10^{10} [$V*M^{-1}$] , normally only sustainable by insulators, such as diamond. Contrary to this requirement, the present application may be operated in low "Ohmic" fields (less than 10^5 [$V*M^{-1}$]).

The IB-diamond of Geis has to be doped to a high doping level (Nitrogen deep dopant with concentration of 10^{24} [M^{-3}]). It has been specified in the amended claims 1 and 53 that

the doping level is less than 10^{14} cm^{-3}. The device of Geis would not work at such low doping levels.

In Geis the back electrode contacts with conically shaped protrusions. This is at least important in cases when the diamond can not be successfully Nitrogen doped. Such shaping is not necessary for the present application.

Summing up, Geis discloses an electron emitter of energetic electrons, the electron emission is from "wide band gap" materials, and moreover the active region is subjected to very large electrical fields. In addition the doping level is very high, and even further the back electrode may comprise conically shaped protrusions.

Shannon discloses an electron source which is "based on the recognition by the inventor that the probability of hot electrons being reflected back into n-type first region from the semiconductor body can be decreased by forming within the body adjacent this surface area a strong electric field to accelerate the hot electrons towards said surface area, and that by providing a p-type doping concentration in a very thin surface region this field can be incorporated in an electron source to aid emission of hot electrons from the surface area, without interfering with the mechanism for injecting hot electrons into the n-type first region" col. 1, lines 45-60.

Thus the invention is not directed to a device or article having a scattering reduction configuration, but addresses the situation at the emitting surface of the device.

In Shannon, energetic electrons are generated and injected into an n-type region 3, by inserting a p-type region 5, the quantum mechanical reflection coefficient at the emitting surface 4 can be decreased. The disclosure is not directed to how the energetic electrons with sufficient energies are made within the very thin region 1, the region being two opposite p-n junctions in series, and how they survive the transport across the regions 3, 4 and 5 without too much energy loss.

All the active layers of the invention by Shannon are very highly doped (the doping levels ranging between 10^{21} and 10^{25} [M^{-3}].

Shannon discloses the deposition of a work function lowering caesium layer on the emitting surface 4. Caesium metal layer on the emitting surface is notoriously known for long term instabilities and the cause of non-homogeneous planar electron emission under load conditions. No such layer is required by the present application.

The entire active multi-layer structure (regions 2, 3, 1, 4 and 5) is very thin (thin film form) and therefore inherently unstable under long term load conditions. In the amended claims 1 and 53 it has been specified that the energetic electron generating region is equal to or larger than 0.2 μm.

Summing up, Shannon discloses an electron source comprising an n-p region to aid emission of hot electrons from the surface area, the electron source comprises highly doped active layers, moreover it comprises a work function lowering caesium layer, and furthermore it has a very thin active multi-layer structure.

In view of the above presented differences between the present application and the two prior art patents, Applicant respectfully submits that the skilled person would not consult either Geis or Shannon and even if he did, the disclosures are so different from the present application that the skilled person would not be led in a direction of the present application. Thus, Geis and Shannon do not render obvious the subject matter recited in the amended claims.

For at least the above reasons, withdrawal of the rejection of claims 1-12 and 53-64 under 35 U.S.C. §103(a) is respectfully requested.

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

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Attachment:
Petition for Extension of Time (Small Entity)

Date: January 11, 2007

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